(12) UK Patent Application (19) GB (11) 2 290 059 (13) A

(43) Date of A Publication 13.12.1995

(21) Application No 9508581.7

(22) Date of Filing 27.04.1995

(30) Priority Data
(31) 06123906 (32) 06.06.1994 (33) JP

(71) Applicant(s)
NSK Ltd

(Incorporated in Japan)

6-3 Ohsaki 1-chome, Shinagawa-ku, Tokyo, Japan

(72) Inventor(s)
Shin Yoshimoto

(74) Agent and/or Address for Service
R G C Jenkins & Co
26 Caxton Street, LONDON, SW1H ORJ,
United Kingdom

(51) INT CL^6
B62D 1/19

(52) UK CL (Edition N)
B7B BSDA
U1S S1820 S1850

(56) Documents Cited
GB 2269345 A GB 2187144 A GB 1365965 A

(58) Field of Search
UK CL (Edition N) B7B BSDA
INT CL^6 B62D 1/18 1/19
ONLINE:- WPI

(54) **Shock absorber for steering column**

(57) In a shock absorbing steering device for relieving a shock applied to a body of a driver who is hit to a steering wheel by reducing a peak load at an initial moment of a secondary collision, a shock energy caused by the secondary collision is absorbed by flexing a bending portion 28 of an energy absorbing plate 24 having a rear end 25 thereof supported by a car body. A slot 29 is formed in the bending portion and a sectional area of the bending portion is consequently reduced so that the bending portion is relatively easy to deform plastically. The bending portion 28 is located in guides 30 and is held in place by a flexing pin 34 and retention plates 32 on support bracelet 4b mounted on the steering column.

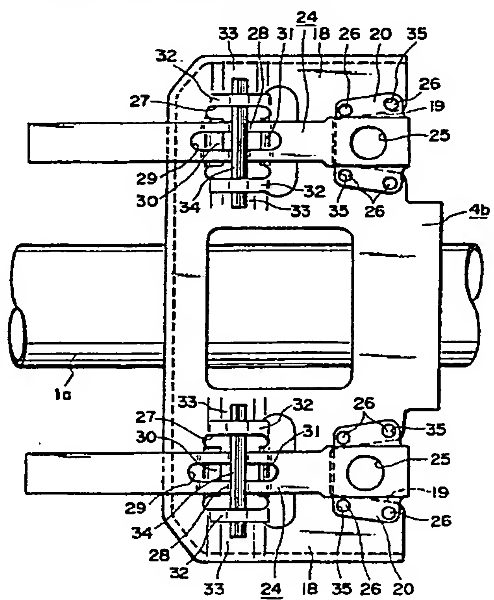

FIG. 1

GB 2 290 059 A

2290059

Energy Absorbing Plate for Shock Absorbing Steering Device

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an energy absorbing plate for a shock absorbing steering device which, at a collision accident, plastically deforms while it absorbs a shock energy to relieve a shock applied to a body of a driver who are hit to a steering wheel.

Related Background Art

In case of a collision accident, following to a primary collision in which a car collides against another car, a secondary collision in which a body of a driver collides against a steering wheel may occur. In order to relieve the shock applied to the body of the driver at the secondary collision to prevent significant injury from being applied to the body of the driver, various types of driver protecting device called a shock absorbing steering device have been proposed. Also, various types of material for absorbing the shock energy at the secondary collision have been known. Of those, an energy absorbing plate has been commonly used as a material which can provide a relatively simple, compact and inexpensive shock absorbing steering device.

Figs. 6 and 7 show an example of a prior art shock absorbing steering device which built in such an energy absorbing plate, disclosed in Japanese Utility Model Publication No. 51-41700. A steering shaft 2 is rotatably supported by a steering column 1 inside the steering column 1. A steering wheel, not shown, is fixed to a rear end (further right end than that shown in Fig. 6) of the steering shaft 2. On the other hand, a support bracket 4 is fixed to a car body 3 by bolts 5. The steering column 1 is inserted in the support bracket 4. The support bracket 4 is not movable even at the collision.

An energy absorbing plate 6 is mounted on a top surface of the steering column 1. The energy absorbing plate 6 is made of a plastically deformable plate such as a soft steel plate, and the front and rear edges thereof (left and right edges in Fig. 6) are fixed by welding to the top surface of the steering column 1. A bending portion 7 projecting upward in hill shape is formed at a center front (left in Fig. 6) portion of the energy absorbing plate 6. Three lateral shafts 8 which are fixed members are spanned at the top of the support bracket 4 and rollers 9 are rotatably supported by the lateral shafts 8. A gap is provided between outer peripheries of adjacent lateral shafts 8, and the bending portion 7 of the energy absorbing plate 6 is positioned at the gap.

The shock absorbing steering device thus constructed acts in the following manner at the collision accident to relieve the shock applied to the body of the driver who is hit to the steering wheel. At the secondary collision, the energy absorbing plate 6 is displaced forward (leftward in Fig. 6) together with the steering column 1. On the other hand, the rollers 9 which are supported by the support bracket 4 through the lateral shafts 8 are not displaced. As a result, the bending portion 7 of the energy absorbing plate 6 is moved to backward (rightward in Fig. 6) of the energy absorbing plate 6 while it is flexed by the rollers 9. The energy absorbing plate 6 is continuously plastically deformed over the length (lateral direction in Fig. 6). Such plastic deformation of the energy absorbing plate 6 is effected by the shock energy applied to the steering column 1 by the secondary collision. Accordingly, the shock energy is absorbed to the extent of the plastic deformation of the energy absorbing plate 6 so that the shock applied to the body of the driver who is hit to the steering wheel is relieved.

Figs. 8 to 10 show a second example of the prior art shock absorbing steering device which built in the energy absorbing plate, disclosed in Japanese Utility Model Application Laid-Open No. 63-142256. A steering shaft 2a is rotatably supported by a steering column 1a

within the steering shaft 2a. The steering column 1a comprises a telescopic combination of an upper column 10 and a lower column 11. Accordingly, the total length of the steering column 1a is shrinked when a strong compression force is applied along an axial direction (lateral direction in Fig. 8). The steering shaft 2a comprises a bar-like upper shaft 12 and a tubular lower shaft 13 coupled by a spline engagement 14. Synthetic resin 17 is filled in circular holes 15 and grooves 16 formed in the spline engagement 14. Accordingly, when a strong compression force is applied along the axial direction of the steering shaft 2a, the synthetic plastic 17 is sheared so that the total length is shrinked. A steering wheel, not shown, is fixed to a rear end (right end in Fig. 8) of the steering shaft 2a.

On the other hand, a support bracket 4a is fixed by welding to an outer periphery at a rear end (right end in Fig. 6) of the upper column 10. The support bracket 4a which is made by press forming a steel plate having a sufficiently high rigidity has a pair of left and right mount plates 18. A notch 19 which opens to a rear edge of the mount plate 18 is formed at a rear end (right end in Figs. 8 to 10) of each of the mount plates 18. An engagement member 20 is mounted at the notch 19. The engagement member 20 is fixed to a car body 3a by bolts 5 which are fixing members. The

engagement member 20 is made of a synthetic resin or aluminum alloy and it is normally held in the notch 19 but when a strong force is applied, it moves out of the notch 19 rearward (rightward in Fig. 8).

A rear end of an energy absorbing plate 6a is engaged to a lower end of the bolt 5. Namely, the lower end of the bolt 5 is inserted to a slot 21 formed at the rear end of the energy absorbing plate 6a to support the rear end of the energy absorbing plate 6a to the car body 3a. On the other hand, a pair of slits 22 are formed, with a space therebetween, in a front (left in Figs. 8 to 10) of each of the mount plates 18. An intermediate area 23 between the slits 22 is bending with the upper surface thereof being bending convexly. A bending portion 7a which is similar to that of the first example described above is formed at a center rear (right in Figs. 8 to 10) area of the energy absorbing plate 6a. A center area of the bending portion 7a is positioned above the intermediate area 23 and the front and rear ends of the bending portion 7a is inserted to the pair of slits 22.

At the collision accident, the shock absorbing steering device thus constructed acts in the following manner to relieve the shock applied to the body of the driver who is hit to the steering wheel. At the secondary collision, the support bracket 4a is displaced forward (leftward in Figs. 8 to 10) together

with the upper column 10. On the other hand, the bolts 5 and the engagement member 20 remain unmoved while they are supported to the car body 3a. Accordingly, the energy absorbing plate 6a having the rear end thereof engaged with the bolts 5 is not displaced beyond a displaceable distance of the bolts 5 within the slits 21 and it is supported while substantially unmoved.

Since the support bracket 4a is displaced forward while the energy absorbing plate 6a is held unmoved, the bending portion 7a of the energy absorbing plate 6a is flexed by the intermediate area 23 and it is moved to the front (left in Figs. 8 to 10) of the energy absorbing plate 6a. The energy absorbing plate 6a is continuously plastically deformed along the length (lateral direction in Figs. 8 to 10). As a result, the shock energy applied to the upper column 10 is absorbed and the shock applied to the body of the driver who is hit to the steering wheel is relieved.

However, the energy absorbing plate built in the prior art shock absorbing steering device described above has the following problem to be resolved. Namely, in any of the above construction, the energy absorbing plate 6 or 6a is plastically deformed by flexing the preformed bending portion 7 or 7a at the secondary collision. Accordingly, in order to assure the absorption of the shock energy, it is required that

the bending portion 7 or 7a is easy to be plastically deformed.

On the other hand, when the bending portion 7 or 7a is formed by the press forming of a metal plate such as a soft steel plate, the bending portion 7 or 7a is hardened during the process and it becomes hard to plastically deform. As a result, the absorption of the shock energy at the secondary collision is reduced accordingly. It is preferable that the shock applied to the body of the driver is as small as possible and an improvement has been demanded.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a highly reliable energy absorbing plate for a shock absorbing steering device.

The energy absorbing plate for the shock absorbing steering device of the present invention is built in a shock absorbing steering device comprising a steering column which rotatably supports a steering shaft therein and is displaced forward by a shock of a collision, a fixing member which is supported to a car body and not displaced by the shock of a collision accident, and an energy absorbing plate which has a bending portion made of a plastically deformable metal plate at an intermediate area thereof and engages with the fixing member and the steering column to absorb the

shock energy caused by the collision accident. Particularly, the energy absorbing plate for the shock absorbing steering device of the present invention has a smaller sectional area of the bending portion forming area than a sectional area of non-forming area.

The energy absorbing plate for the shock absorbing steering device of the present invention thus constructed absorbs the shock energy by moving the bending portion lengthwise at the secondary collision while it flexes the bending portion to relieve the shock applied to the body of the driver who is hit to the steering wheel. Particularly, in the energy absorbing plate for the shock absorbing steering device of the present invention, the sectional area of the bending portion forming area is smaller than the sectional area of the non-forming area so that the bending portion forming area is easier to plastically deform. Accordingly, even if the bending portion forming area is hardened during the process, the bending portion does not become hard to plastically deform and the effect of the absorption of the shock energy is enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a plan view of major portions of a shock absorbing steering device having an energy absorbing plate built therein, in accordance with a

first embodiment of the present invention;

Fig. 2 shows a side elevational view thereof, partly cut;

Fig. 3 shows a diagram of a result of experiment done to confirm an effect of the present invention;

Fig. 4 shows a partial plan view of the energy absorbing plate in accordance with a second embodiment of the present invention;

Fig. 5 shows a partial side elevational view thereof;

Fig. 6 shows a side elevational view with a partially longitudinally sectional view of a first example of a prior art construction;

Fig. 7 shows a VII-VII sectional view of Fig. 6;

Fig. 8 shows a side elevational view with a partially longitudinally sectional view of a second example of a prior art construction;

Fig. 9 shows a partial plan view thereof; and

Fig. 10 shows a perspective view as viewed in a direction X of Fig. 8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figs. 1 to 3 show a first embodiment of the present invention. A steering shaft 2a is rotatably supported by a steering column 1a within the steering column 1a. A support bracket 4b is fixed by welding to an outer periphery at a rear end of the steering column

1a. The support bracket 4b which is formed by press forming a steel plate having a sufficiently high rigidity has a pair of left and right mount plates 18. A notch 19 which opens to a rear edge of the mounting late 18 is formed at a rear end (right end in Fig. 1) of each of the mounting plates 18. An engagement member 20 is mounted in each of the notches 19. The engagement members 20 are fixed to a car body by bolts, not shown, which are fixing members. The engagement members 20 are made of aluminum alloy and they are normally held in the notches 19 by synthetic resin 26 which spans across holes 35 formed in the engagement members 20 and other holes formed in the mounting plates 18 to align to the holes 35. When a strong shock is applied by the secondary collision, the synthetic resin 26 is sheared so that a support force is lost and the engagement members 20 move out of the notches 19 to the rear (right in Figs. 1 and 2).

The rear ends of the energy absorbing plates 24 are engaged to the lower ends of the bolts through the engagement members 20 when they are mounted to the car. Namely, the lower ends of the bolts are inserted into circular holes 25 formed at the rear ends (right ends in Figs. 1 and 2) of the energy absorbing plate 24 to support the rear ends of the energy absorbing plates 24 by the car body. Bending portion 28 which project downward in a hill shape are formed at center rear

portions (right portions in Figs. 1 and 2) of the energy absorbing plates 24. Particularly, in the energy absorbing plates 24 of the present invention, slots 29 extending longitudinally (laterally in Figs. 1 and 2) are formed at widthwise center portions of the forming areas of the bending portions 28. The sectional area (thickness × width of solid area) of the forming areas of the bending portions 28 is set smaller than the sectional area (thickness × width) of the area (non-forming area) in which the bending portions 28 are not formed.

On the other hand, holes 27 are formed at the front areas (left areas in Figs. 1 and 2) of the mounting plates 18. Front guide plates 30 having a quarter circle arc in sectional view and having leading edges thereof projected downward are formed at front edges (left edges in Figs. 1 and 2) of the holes 27 at portions of the mounting plates 18. Rear guide plates 31 having a generally inverted U-shape in sectional view and having the leading edges thereof projected downward are formed in the rear edges (right edges in Figs. 1 and 2) of the holes 27. A pair of retention plate 32 and reception plate 33 are formed at each of the left and right edges (upper and lower edges in Fig. 1) of each of the holes 27.

The retention plate 32 and the reception plate 33 are provided adjacently to each other while the

公報オリジナルが不鮮明とのこと。

shock energy caused by the collision accident. Particularly, the energy absorbing plate for the shock absorbing steering device of the present invention has a smaller sectional area of the bending portion forming area than a sectional area of non-forming area.

The energy absorbing plate for the shock absorbing steering device of the present invention thus constructed absorbs the shock energy by moving the bending portion lengthwise at the secondary collision while it flexes the bending portion to relieve the shock applied to the body of the driver who is hit to the steering wheel. Particularly, in the energy absorbing plate for the shock absorbing steering device of the present invention, the sectional area of the bending portion forming area is smaller than the sectional area of the non-forming area so that the bending portion forming area is easier to plastically deform. Accordingly, even if the bending portion forming area is hardened during the process, the bending portion does not become hard to plastically deform and the effect of the absorption of the shock energy is enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a plan view of major portions of a shock absorbing steering device having an energy absorbing plate built therein, in accordance with a

hand, the bolts and the engagement members 20 remain unmoved while they are supported by the car body. Accordingly, the energy absorbing plates 24 having the rear ends thereof engaged with the bolts are not displaced forward and supported unmoved.

Since the support bracket 4b is displaced forward while the energy absorbing plates 24 are supported unmoved, the bending portions 28 of the energy absorbing plates 24 are flexed between the front guide plates 30 and the rear guide plates 31 and the lower surfaces of the flexing pins 34 and moved forward (leftward in Figs. 1 and 2) of the energy absorbing plates 24. The energy absorbing plates 24 are continuously plastically deformed lengthwise (lateral direction in Figs. 1 and 2). As a result, the shock energy applied to the steering column 1a is absorbed and the shock applied to the body of the driver who is hit to the steering wheel is relieved.

Particularly, in the energy absorbing plates 24 for the shock absorbing steering device of the present invention, the sectional area of the forming area of the bending portions 28 is smaller than the sectional area of the non-forming area to the extent of the formation of the slots 29. Accordingly, the forming area of the bending portions 28 is easy to plastically deform, and even if the forming area of the bending portions 28 is hardened during the process, the bending

portions 28 do not become hard to plastically deform. As a result, the effect of absorption of the shock energy at the secondary collision is enhanced. Since the sectional area of the area (non-forming area) other than the forming area of the bending portions 28 is secured sufficiently, the force required to flex between the front guide plates 30 and the rear guide plates 31 and the lower surfaces of the flexing pins 34 is not reduced too much. Accordingly, a sufficient magnitude of energy absorbable by the energy absorbing plates 24 is secured.

The inventors of the present invention measured the shock loads axially applied to the steering column 1a when the steering column 1a is displaced downward while the pair of energy absorbing plates 24 having the slots 29 formed therein and the energy absorbing plates having such slots 29 not formed therein are built in the shock absorbing steering column device as shown in Figs. 1 and 2 and obtained a result as shown in Fig. 3. The material of the energy absorbing plate is SPCC (JIS G 3141) which is a cold milled steel belt having a width of 14 mm and a thickness 1.2 mm. A width of the slot 29 is 7 mm.

Of the two curves shown in Fig. 3 which represent the experiment result, a solid line α represents a load when the slot is not formed, and a broken line β represents a load when the slots 29 are formed. As

seen from Fig. 3, by the use of the energy absorbing plate of the present invention, the peak load created at the initial moment of the secondary collision can be suppressed while a sufficient energy absorption capability (200 kgf in the experiment) is secured. Accordingly, the shock applied to the body of the driver who is hit to the steering wheel can be relieved.

Figs. 4 and 5 show a second embodiment of the present invention. In the first embodiment described above, the slot 29 (Fig. 1) is formed at the widthwise center of the bending portion 28 of the energy absorbing plate 24 to reduce the sectional area of the bending portion 28. In the present embodiment, the width of the bending portion 28 is reduced to reduce the sectional area of the bending portion 28. The effect when it is built in the shock absorbing steering device is same as that of the first embodiment.

The essential feature of the present invention does not lie in the structure of the shock absorbing steering device having the energy absorbing plates 24 built therein. Accordingly, the present invention may be applied to the energy absorbing plates 6 and 6a built in either the structure shown in Figs. 6 and 7 or the structure shown in Figs. 8 to 10.

The energy absorbing plate for the shock absorbing steering column of the present invention is constructed

and operates as described above and can suppress the peak load created at the initial moment of the secondary collision. Thus, the shock applied to the body of the driver who is hit to the steering wheel is released and the security of the life of the driver is attained.

CLAIMS

1. An energy absorbing plate adapted to be built in a shock absorbing steering device, comprising:

a steering column for rotatably supporting a steering shaft therein and being displaceable forward by a shock of a collision accident;

a fixed member supported by a car body and not displaceable by the shock of the collision accident; and

an energy absorbing plate formed by a plastically deformable metal plate and having a bending portion formed in a center area thereof and engaged with said fixed member and said steering column for absorbing a shock energy caused by the collision accident;

characterized by that a sectional area of a forming area of said bending portion is smaller than a sectional area of a non-forming area.

2. An energy absorbing plate for a shock absorbing steering device according to Claim 1, wherein a longitudinally extending slot is formed at widthwise center of said bending portion.

3. An energy absorbing plate for a shock absorbing steering device according to Claim 1, wherein a width of said bending portion is reduced.

4. An energy absorbing plate substantially as herein described with reference to Figures 1 and 2 or Figures 4 and 5 of the accompanying drawings.

5. An energy absorbing steering device including a plate as claimed in any one of the preceding claims.

6. In or for use in an energy absorbing steering apparatus including a strip deforming means, an energy absorbing member which includes a strip having an undulation adapted to accommodate said strip deforming means, which undulation has a transverse cross-sectional area less than that of the remainder of the strip.

19 The Patent Office

Application No:	GB 9508581.7	**Examiner:**	David Whitfield
Claims searched:	1-6	**Date of search:**	13 July 1995

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): B7B (BSDA) F2S (SCM)

Int Cl (Ed.6): B62D 1/18 B62D 1/19

Other: ONLINE:- WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB2269345A (K.K.Y.S.) (see figs 28-38)	1,3,5,6
"	GB2187144A (TRW) (see figs. 6 and 7)	"
"	GB1365965 (B.M.W.) (see p4 ll. 15-27)	"

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		

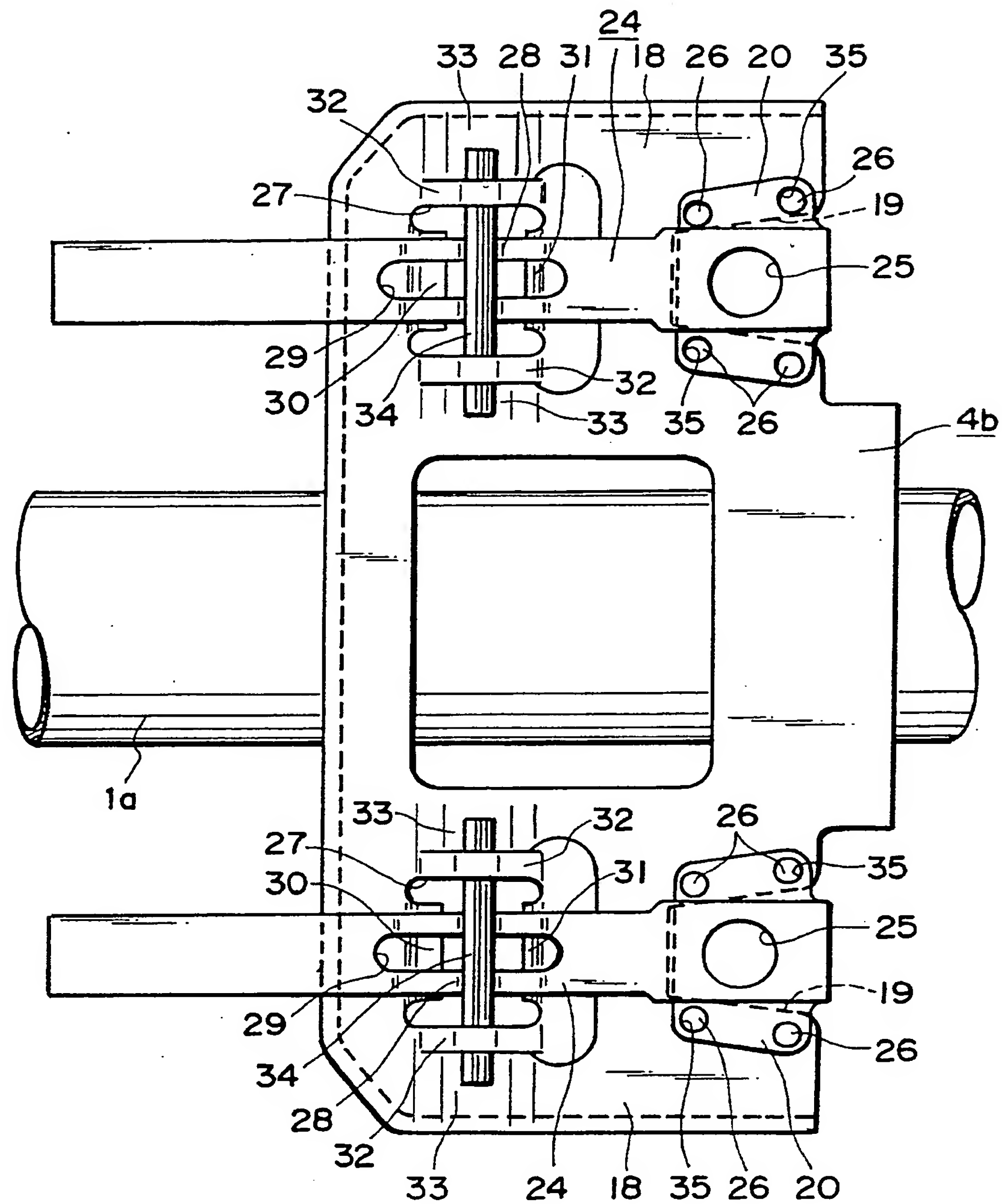
24
33
28
31
18
26
20
35
32
26
27
19
25
29
30
34
32
33
35
26
4b
1a
33
32
27
30
26
31
35
25
19
29
34
28
26
32
33
24
18
35
26
20

FIG. I

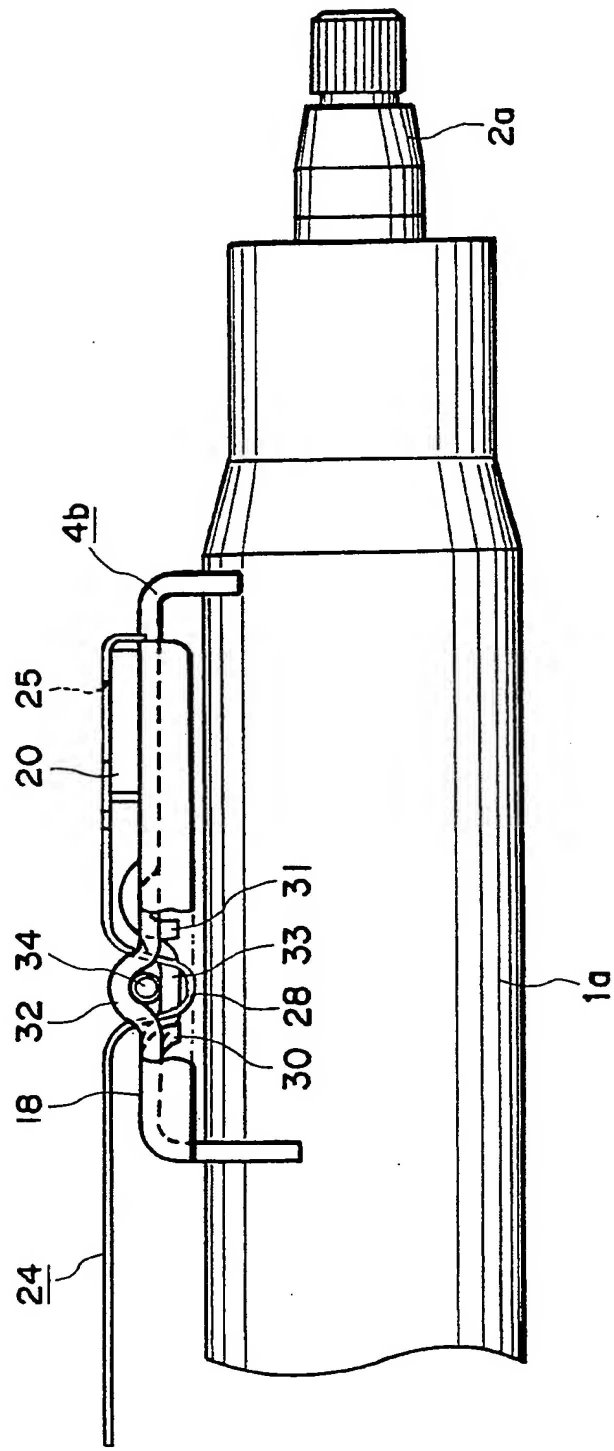

FIG. 2

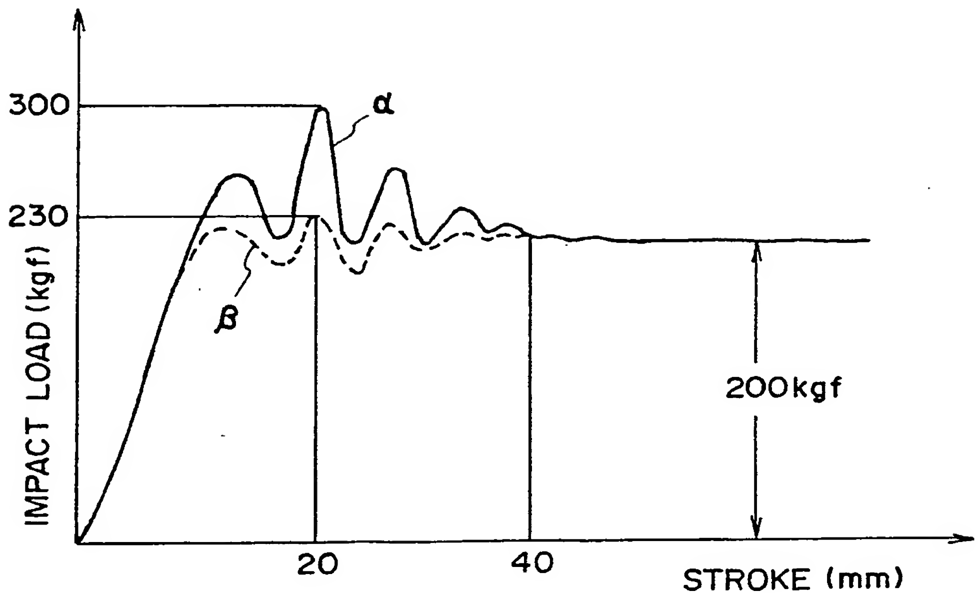

FIG. 3

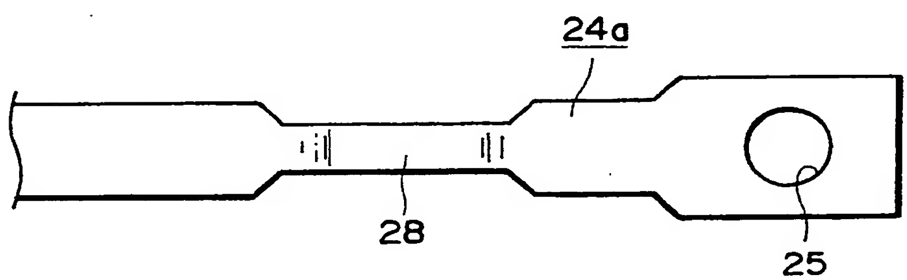

FIG. 4

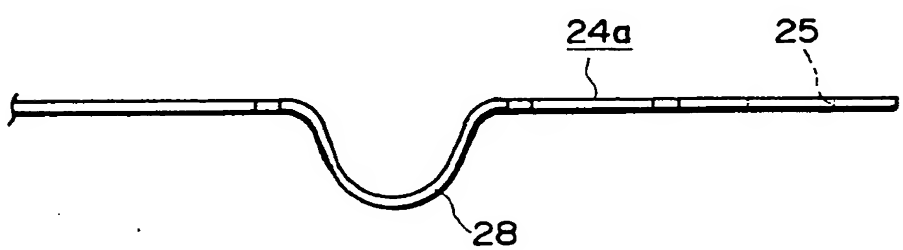

FIG. 5

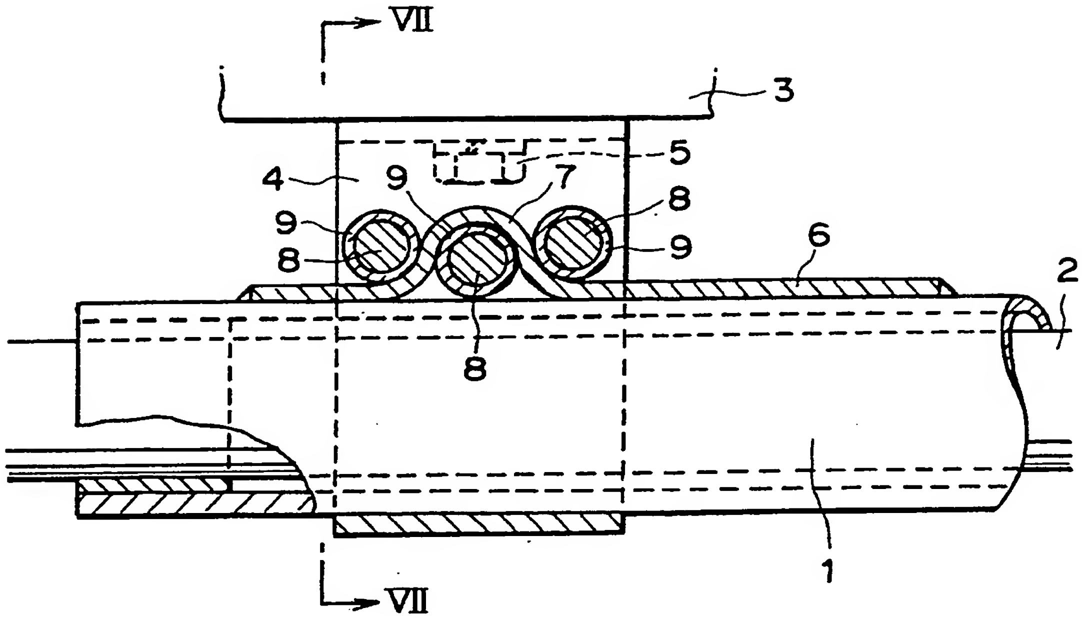

FIG. 6
PRIOR ART

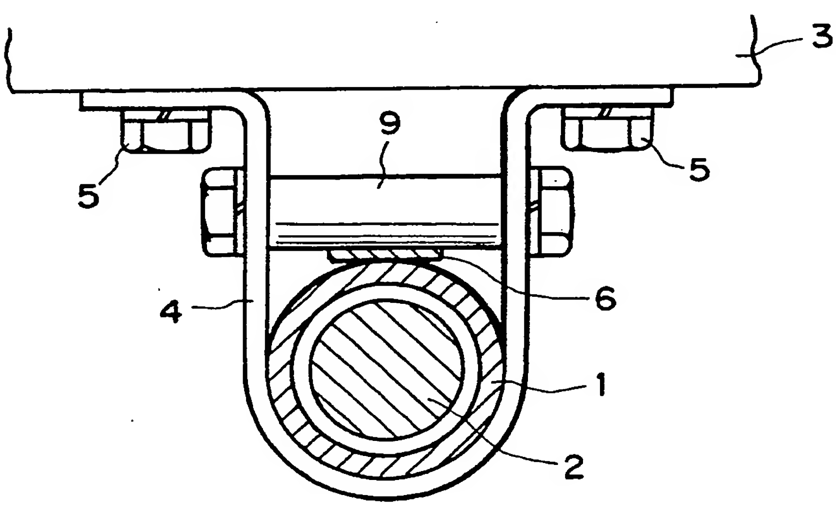

FIG. 7
PRIOR ART

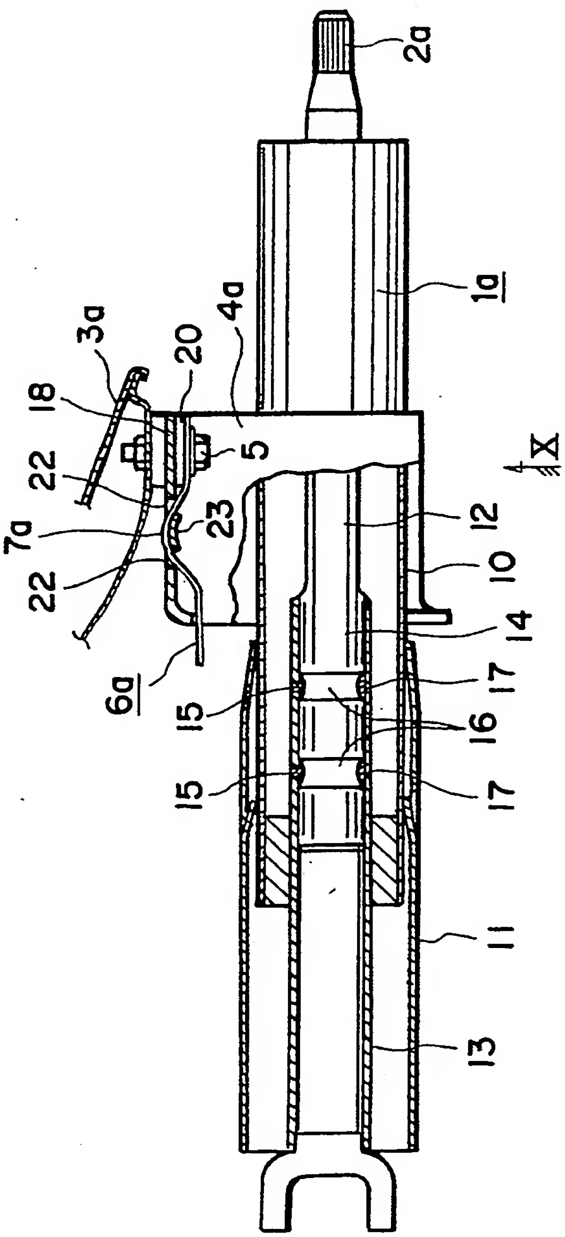

FIG. 8
PRIOR ART

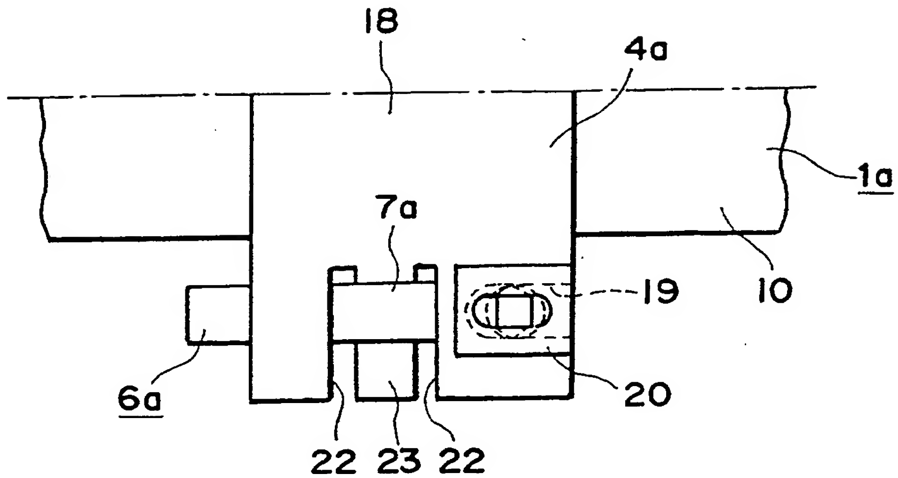

FIG. 9
PRIOR ART

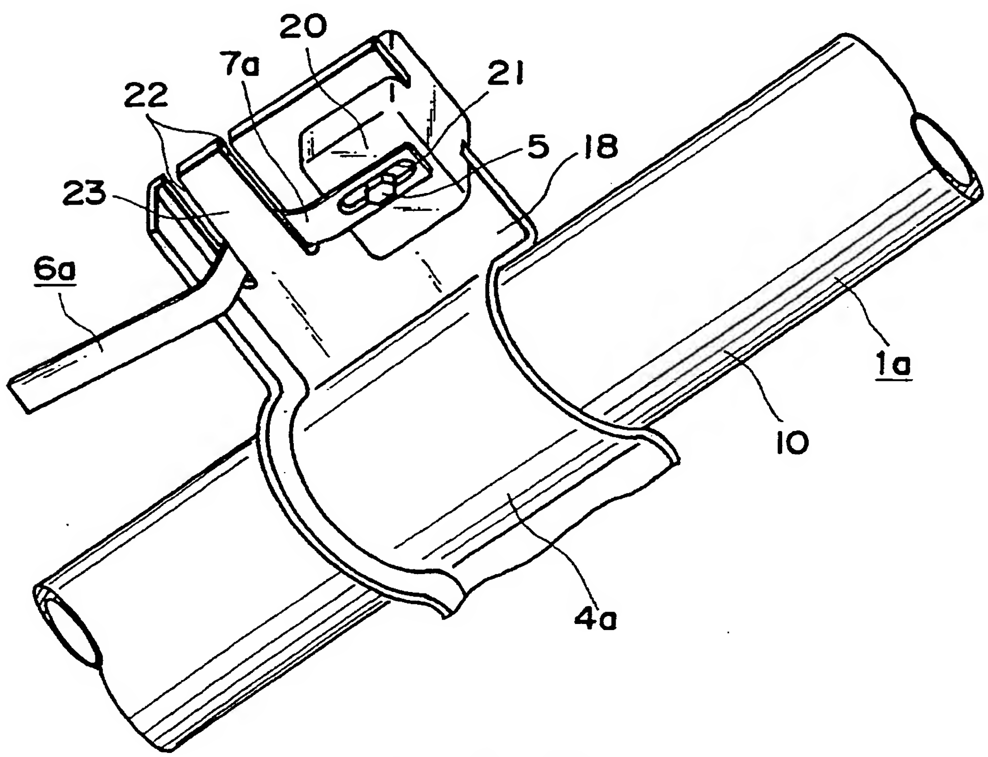

FIG. 10
PRIOR ART